Tunable negative refraction in photonic lattices

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Propagation of light in photonic structures with a periodic modulation of the refractive index is defined through the diffraction properties of the extended eigenmodes in the form of Floquet-Bloch waves. At the boundaries of the structure, beams experience refraction at the angle proportional to the difference of the diffraction coefficients inside the structure and in a free space. Because the Bloch-wave diffraction depends strongly on the refractive-index contrast, this refraction could be effectively controlled if the lattice depth is dynamically modified. The differences in the diffraction properties of the Bloch waves corresponding to different bands of the transmission spectrum can be used to spatially separate them in the structure [1].

In this work we investigate both positive and negative refraction of light associated with different spectral bands of a photonic lattice. We predict theoretically and demonstrate experimentally *tunable negative refraction* of beams associated with the top of the second band of an optically-induced photonic lattice. We show tunability of the output beam position on the dynamically reconfigurable lattice depth. At higher laser intensities, the light becomes self-trapped propagating in the form of a spatial gap soliton [2], while preserving the basic steering properties and negative refraction.

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[2] D. Neshev, A. A. Sukhorukov, B. Hanna, W. Krolikowski, and Yu. S. Kivshar, Phys. Rev. Lett. **93**, 083905 (2004).